SOME DEVELOPMENTS IN REMOTE SENSING AT THE NORTHERN FOREST RESEARCH CENTRE

C.L. KIRBY
Northern Forest Research Centre
Canadian Forestry Service
Environment Canada
5320 - 122 Street
Edmonton, Alberta T6H 3S5

ABSTRACT

Rapidly rising costs of conventional forest inventory are contributing to a renewed interest in methods to reduce costs. I think that remote sensing has the kerosene to light some fires that will help obtain forest inventories at reduced cost.

This reminds me of a story about a young geologist, just out of graduate school with a fresh Ph.D., who was sitting in on his first wildcat oil well. His client was a hard-crusted, bitter, tough guy who worried about the money and knew little geology and certainly no scientific nomenclature. At two o'clock in the morning the graduate called his client and said, "We just penetrated the Miocene with a drill bit." The next night he called his client and said, "We just penetrated the Oligocene." The following early morning he called his client and said, "We just penetrated the Eocene." The old man responded, "Son, don't call me any more until you reach Kerosene."

Over the past 10 years, research and development in remote sensing have been carried out at the Northern Forest Research Centre (NoFRC) in the following areas:

1. multistaged and multiphased inventory approaches,
2. digital and optical satellite image interpretation,
3. small-scale color infrared aerial photography,
4. large-scale photo sampling, and
5. computer mapping and data base management systems.

MULTISTAGED AND MULTIPHASED INVENTORY APPROACHES

The first Canadian test of multistaged inventory was on the P-6 management unit in Alberta. This study indicated that highly efficient estimates of merchantable softwood volume could be made for large areas at low cost. The approach involved using estimates of merchantable softwood volume obtained from LANDSAT imagery and digital tapes to guide subsequent sampling.

Subsequent sampling was made proportional to the aerial occurrence of softwood as determined in the first stage based on LANDSAT. This focused the sampling on the areas with softwood timber and required only one-third of the samples that would have been required for simple random sampling. The approach used for the P-6 test site (Kirby and van Eck 1977) was also used by the Simpson Timber Company for its lease area at Whitecourt, Alberta. Inventory costs were reduced, and the results were found to be satisfactory. Multistaged sampling design should be suitable for insect and disease damage surveys but may require aerial photography in the first stage to detect the damage. The only successful detection of forest damage on LANDSAT by NoFRC was of red belt (Kirby et al. 1975).

DIGITAL AND OPTICAL SATELLITE IMAGE INTERPRETATION

Both optical and digital satellite image interpretation techniques are available at NoFRC. In our work with satellite imagery we have found that both approaches give similar results in many cases. The digitally produced pictures usually produce the best-quality picture at greater cost when only small areas are involved, but when themes for large areas are to be interpreted, digital techniques may be the most economic approach. At present NoFRC has an unsupervised classifier for digital image classification developed by Goldberg and Shlien (1976). This software was put on the PDP 11-60 at NoFRC with assistance from the Petawawa National Forestry Institute. Preliminary evaluation indicates the classifier works well on our system, so that it will be possible to integrate image classification with computer mapping techniques that will be available at NoFRC in 1982.

SMALL-SCALE COLOR INFRARED AERIAL PHOTOGRAPHY

Considerable savings in forest inventory cost may be achieved with the use of small-scale aerial photographs. On the P-6 test site it was demonstrated that color infrared photography at a scale of 1:100 000 could produce similar results to an inventory obtained from 1:20 000 aerial photographs in infrared black and white. The use of a small scale requires good interpretation equipment such as the Zeiss-Jena Interpretoskop available at NoFRC. With this equipment and the color infrared photographs previously described, it was possible to detect forest damage where the trees had been turned red by flooding in patches as small as 0.1 ha on the original positive transparencies. The quality of color infrared aerial photography is greatly reduced when printed on paper.

LARGE-SCALE PHOTO SAMPLING

NoFRC has pioneered the use of large-scale aerial photographs taken from helicopters (Kirby 1980). This approach greatly reduces the cost of ferrying aircraft to various sites. The camera system consists of a Honeywell radar altimeter, two 70-mm Vinten cameras, and an intervalometer built in-house. Height of aircraft above ground is recorded digitally on each exposure taken.

With large-scale photographs at a scale of 1:400 it is possible to detect coniferous forest regeneration as small as 0.3 m, and with photographs at a scale of 1:1000, timber volumes of individual trees may be determined and tree heights estimated to an accuracy of 1 m. The system is being upgraded so that it may be mounted with MOT approval on a Bell 206 or Cessna 172 using a pod developed by the U.S. Air Force for the Department of Environment. The cameras in the pod may be rotated to correct for drift as detected on the television tracking camera. The system will have a microcomputer for controlling the cameras and recording readings from the radar altimeter and the tip and tilt indicator.

COMPUTER MAPPING AND DATA BASE MANAGEMENT SYSTEMS

At present the technological developments in this area are far ahead of applications in forestry, and there is a need for demonstrations of various approaches. A computer mapping system is being developed for this center that will have the capability to integrate map and satellite information so that inventories may be speedily updated for changes resulting from fire and clear-cutting. Thematic maps in color may be produced by the system.

CONCLUSION

The transfer of technology in remote sensing has not been as quick as was first thought possible. The continuing work at NoFRC is now beginning to provide some tangible results that are being used to improve approaches to forest inventory.

REFERENCES

Goldberg, M. and S. Shlien. 1976. Computer implementation of a four-dimensional clustering algorithm. Dep. Energy Mines Resour., Can. Cent. Remote Sensing, Ottawa. Res. Rep. 76-2.

Kirby C.L. 1980. A camera and interpretation system for assessment of forest regeneration. Environ. Can., Can. For. Serv., North. For. Res. Cent. Edmonton, Alberta. Inf. Rep. NOR-X-221.

Kirby, C.L., D. Goodenough, D. Day, and P. van Eck. 1975. LANDSAT imagery for Banff and Jasper national parks inventory and management. Pages 207-225 in Proceedings of the Third Canadian Remote Sensing Symposium, Edmonton, Alberta.

Kirby, C.L. and P.I. van Eck. 1977. A basis for multistage forest inventory in the boreal forest region. Pages 71-94 in Proceedings of the Fourth Canadian Symposium on Remote Sensing, Quebec City, Quebec.

Todd, B. and B. Roosen. 1981. Goldberg's unsupervised classifier: PDP 11/T34 version. Environ. Can., Can. For. Serv., Petawawa Natl. For. Inst. Chalk River, Ontario. File report.

ISSN 0704-7673

USES OF REMOTE SENSING IN FOREST PEST DAMAGE APPRAISAL

Proceedings of a seminar held May 8, 1981, in Edmonton, Alberta

COMPILED BY

R.J. HALL

INFORMATION REPORT NOR-X-238
FEBRUARY 1982

NORTHERN FOREST RESEARCH CENTRE
CANADIAN FORESTRY SERVICE
ENVIRONMENT CANADA
5320 - 122 STREET
EDMONTON, ALBERTA
T6H 3S5

Hall, R.J. (Compiler). 1982. Uses of remote sensing in forest pest damage appraisal. Proceedings of a seminar held May 8, 1981, in Edmonton, Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent. Edmonton, Alberta. Inf. Rep. NOR-X-238.

ABSTRACT

A seminar was held to review experiences and concerns in the application of remote sensing techniques to forest pest damage appraisal. Papers were presented on detection and analysis of vegetative stresses; application of remote sensing to mountain pine beetle management in southern Alberta; practical applications of remote sensing for forest pest damage assessment; some recent developments in remote sensing at the Northern Forest Research Centre; the role, informational requirements, and pest problems of the Forest Insect and Disease Survey (FIDS); FIDS-related remote sensing studies in the Pacific region; and the uses of remote sensing in forest pest damage appraisal.

RESUME

Un séminaire a été organisé pour passer en revue les expériences réalisées et les sujets d'intérêt dans le domaine de l'application des techniques de télédétection à l'estimation des dégâts des ravageurs forestiers. Des communications ont été présentées sur la détection et l'analyse des agressions de la végétation; l'application de la télédétection à la répression du dendroctone du pin ponderosa dans le sud de l'Alberta; les applications pratiques de la télédétection pour la détermination des dégâts des ravageurs forestiers; les innovations récentes dans le domaine au Centre de recherches forestières du Nord; le rôle, les exigences en matière d'information et les problèmes suscités par les ravageurs au Relevé des insectes et des maladies des arbres forestiers (RIMAF); les études sur la télédétection ayant trait au RIMAF dans la région du Pacifique, et les utilisations de la télédétection pour évaluer les dégâts des ravageurs forestiers.